

**Supplementary materials of “Dual Megathrust Slip Behaviors of the
2014 Iquique Earthquake Sequence”**

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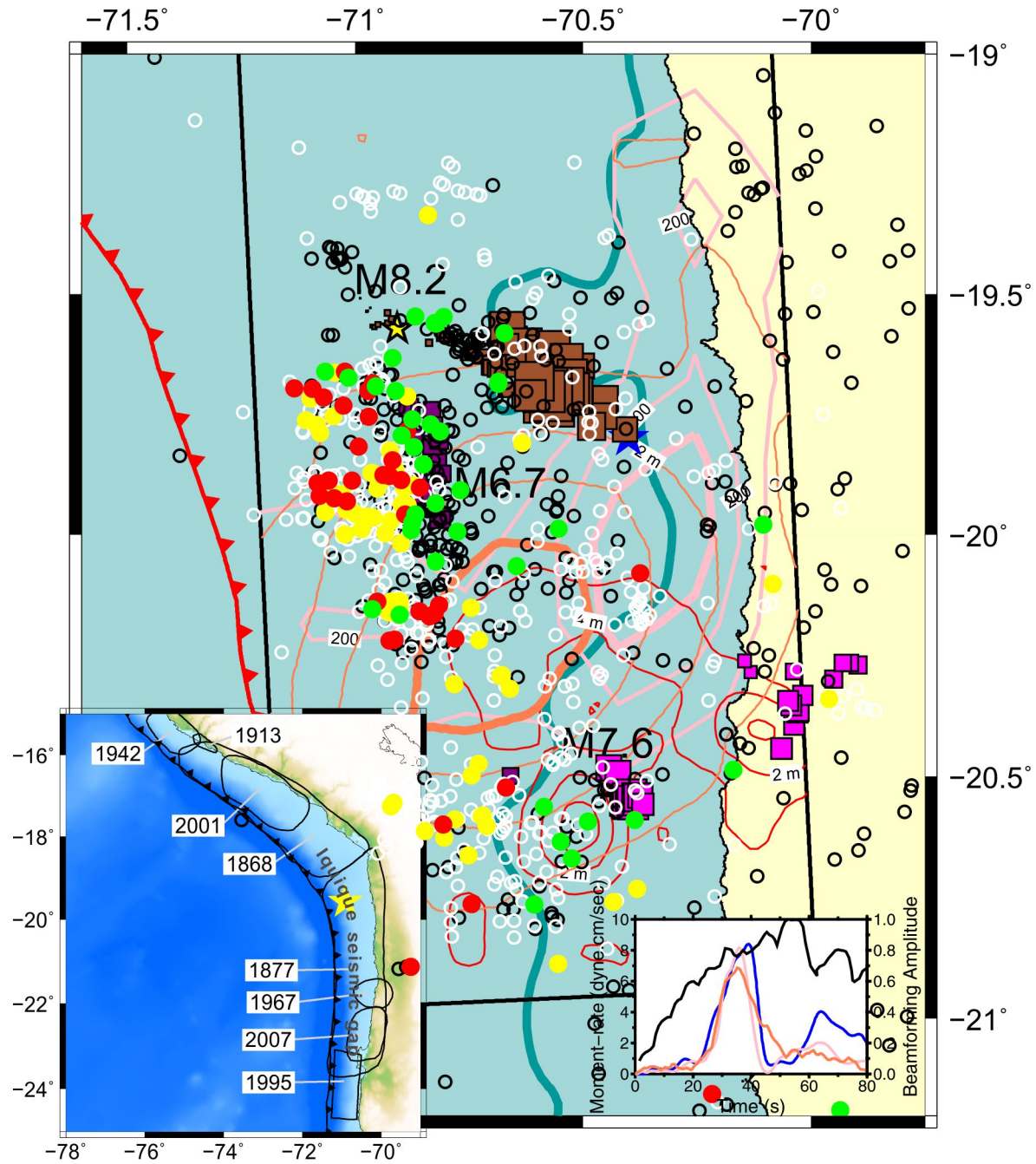


Figure S1. Similar with Figure 1 except with the pink (the Caltech model) and orange (the Yagi et al., model) contour lines showing two finite-fault models instead of the Hayes et al., model (blue contour lines) shown in Figure 1. The black open and white circles denote Mw > 4 foreshocks and aftershocks, respectively.

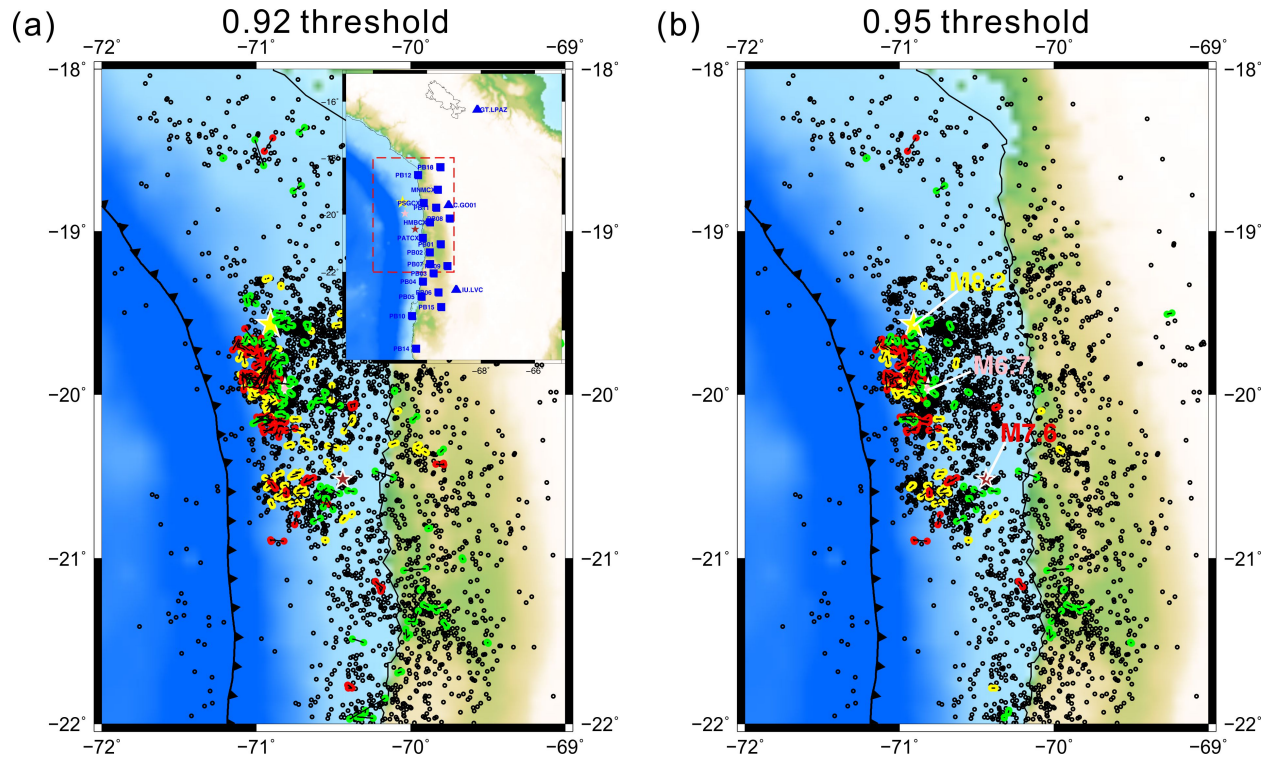
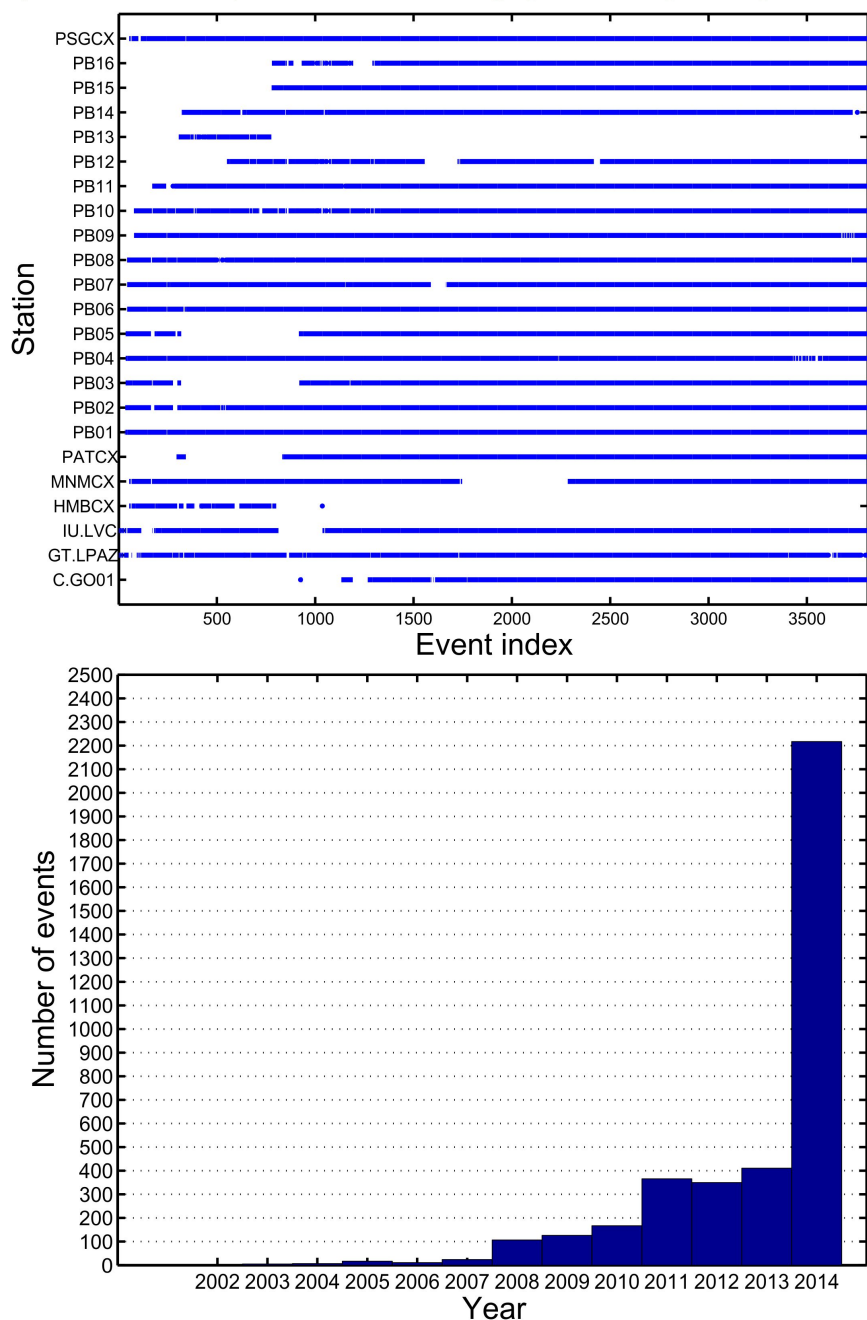
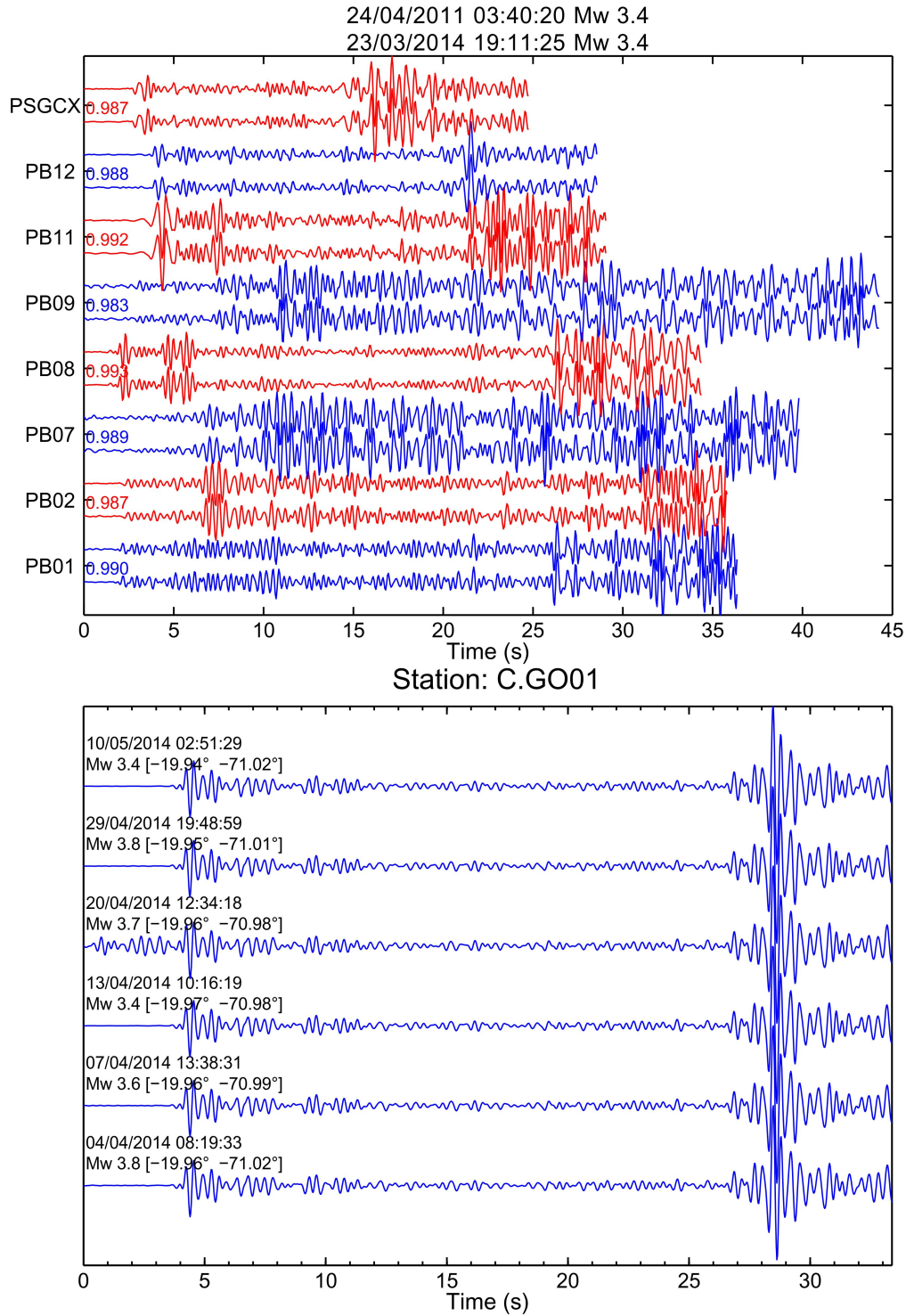


Figure S2. (a) & (b) show the distributions of the repeaters processed using two thresholds (0.92 and 0.95), respectively. The inset map of (a) shows the 23 stations used. The black open circles display seismicity from 2002 to 2014 ($M_w \geq 2.5$, depth ≤ 80 km). The yellow dots denote repeater groups which contain only events after the mainshock, the green dots denote groups containing only events before the mainshock, and the red dots denote groups containing events both before and after the mainshock. The repeating events of the same sequence or pairs are connected with lines. The yellow, pink and red stars represent the epicenter of the Mw 8.2 mainshock, Mw 6.7 foreshock and Mw 7.6 aftershock, respectively.

Total: 3809
($M_w \geq 2.5$, depth ≤ 80 km, Long. $[-72^\circ -69^\circ]$, Lat. $[-22^\circ -18^\circ]$)

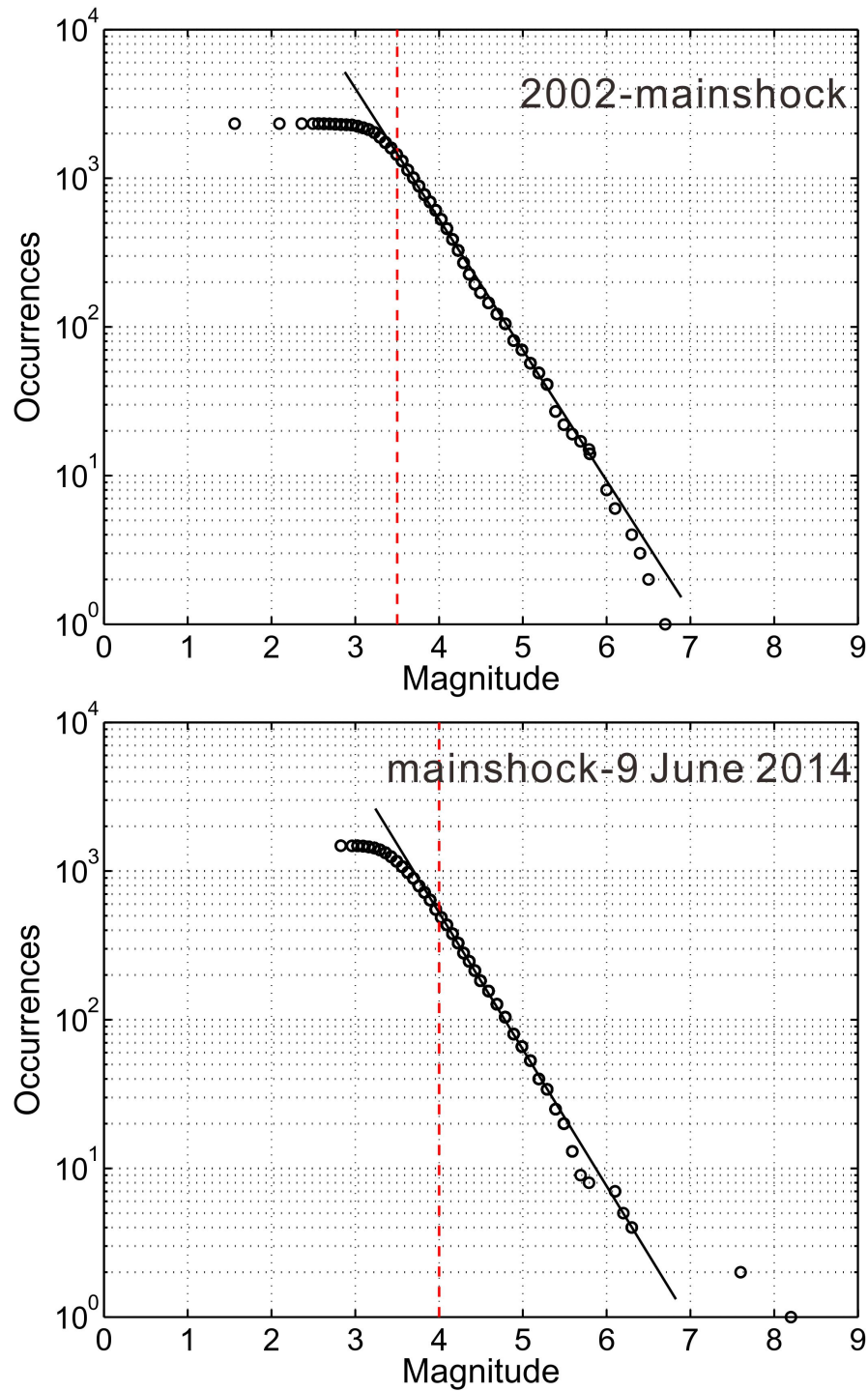


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31 Figure S3. Upper: lines or dots indicate that the data are available at the corresponding event;
32 Lower: The temporal distribution of the 3809 events from 1 March 2002 to 9 June 2014 in the
33 catalog ($M_w \geq 2.5$, depth ≤ 80 km), determined by the Centro Sismológico Nacional (CSN).



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35 Figure S4. Upper: One example of identified pair of repeating earthquakes. The correlation coefficients
36 are shown between the waveforms (1-4 Hz) recorded by different stations. Note that this pair expands a
37 time period of about 3 years. Lower: Example showing a repeating sequence recorded at one station
38 GO01.



39

40 Figure S5. Completeness of magnitude in the CSN catalog for events with depth ≤ 80 km in the study
 41 region. The upper figure shows that the magnitude is complete down to about 3.5 from 2002 to the 2014
 42 Mw 8.2 mainshock. The lower figure shows that the magnitude of completeness is about 4 after the
 43 mainshock. The black line denotes the approximate Gutenberg-Richter distribution.

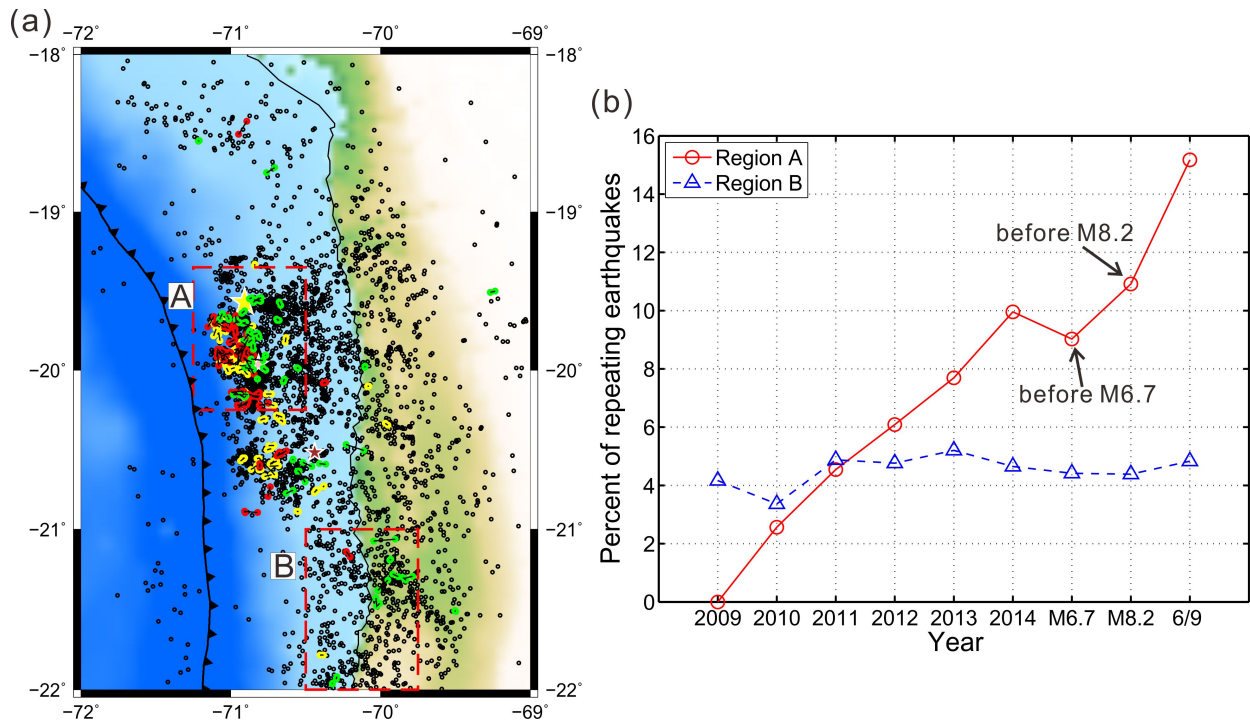


Figure S6. (a). Map showing the two selected regions (A and B) for comparison of fraction of repeaters. (b). The two curves showing the fraction of repeaters before the corresponding time for the two regions shown in (a).

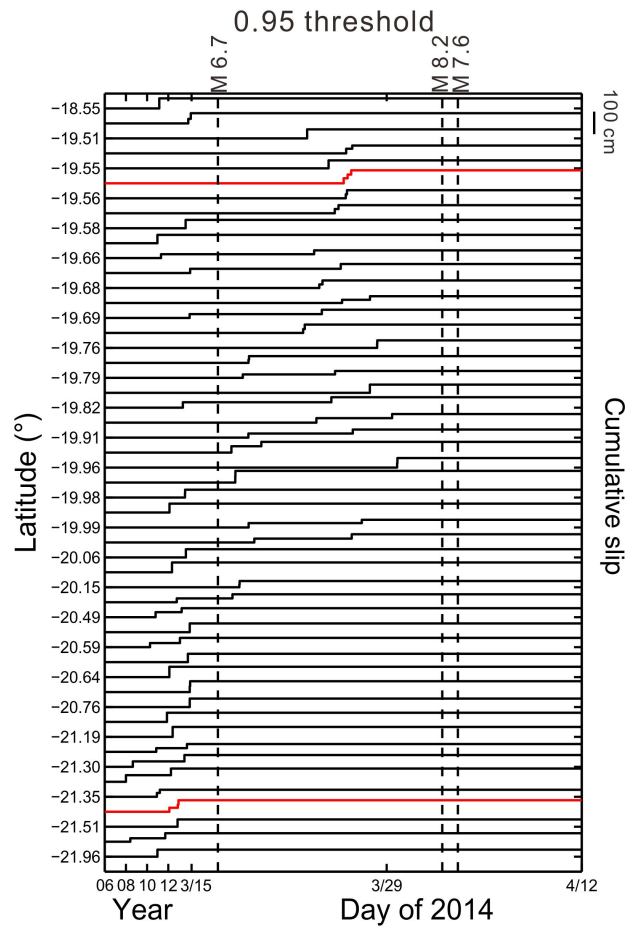
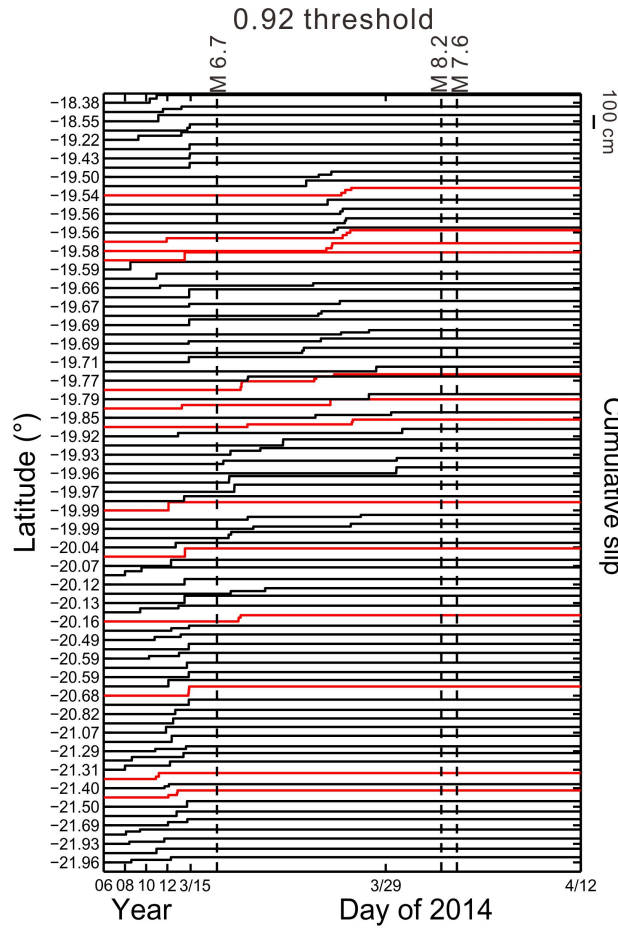
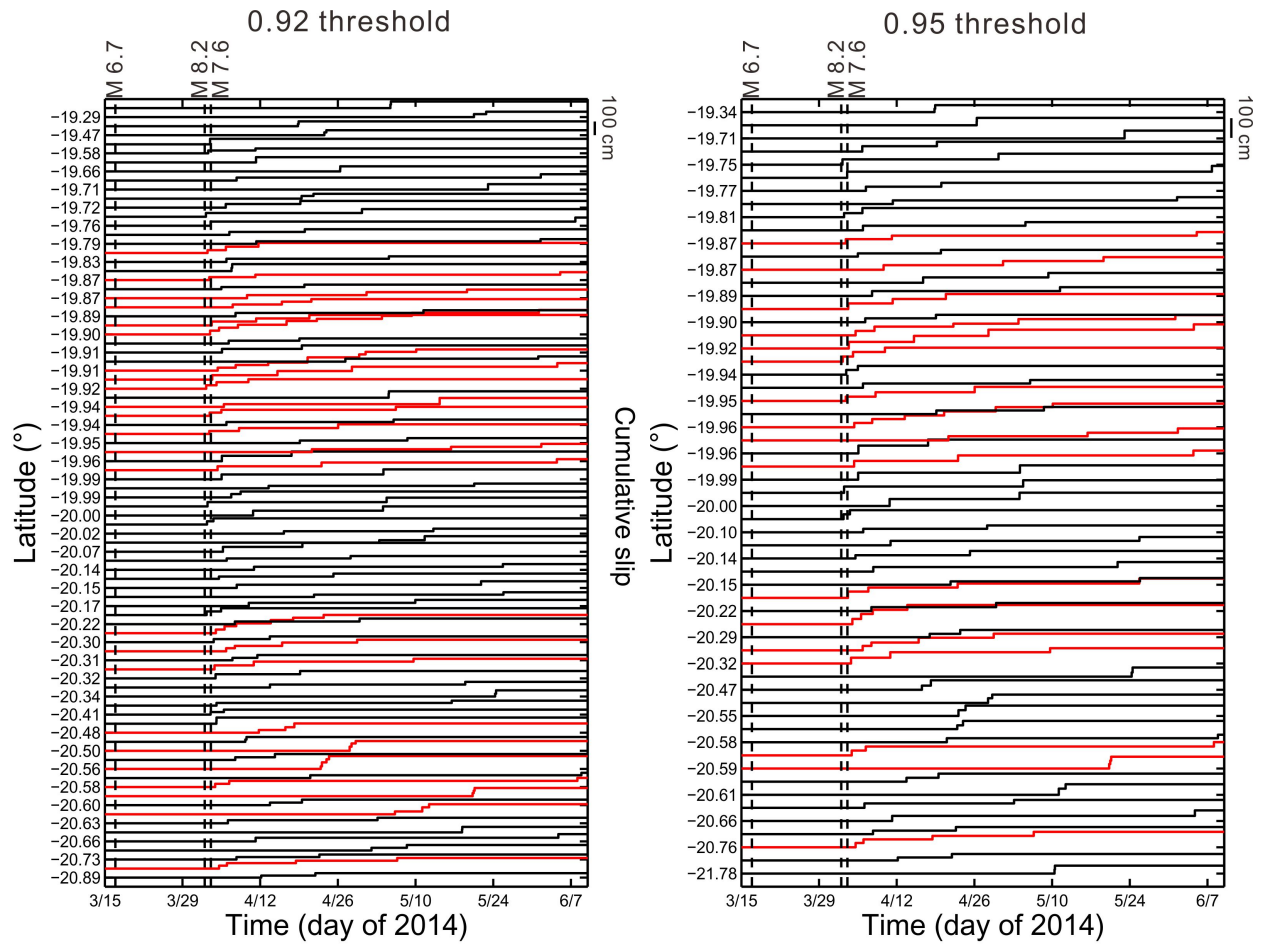


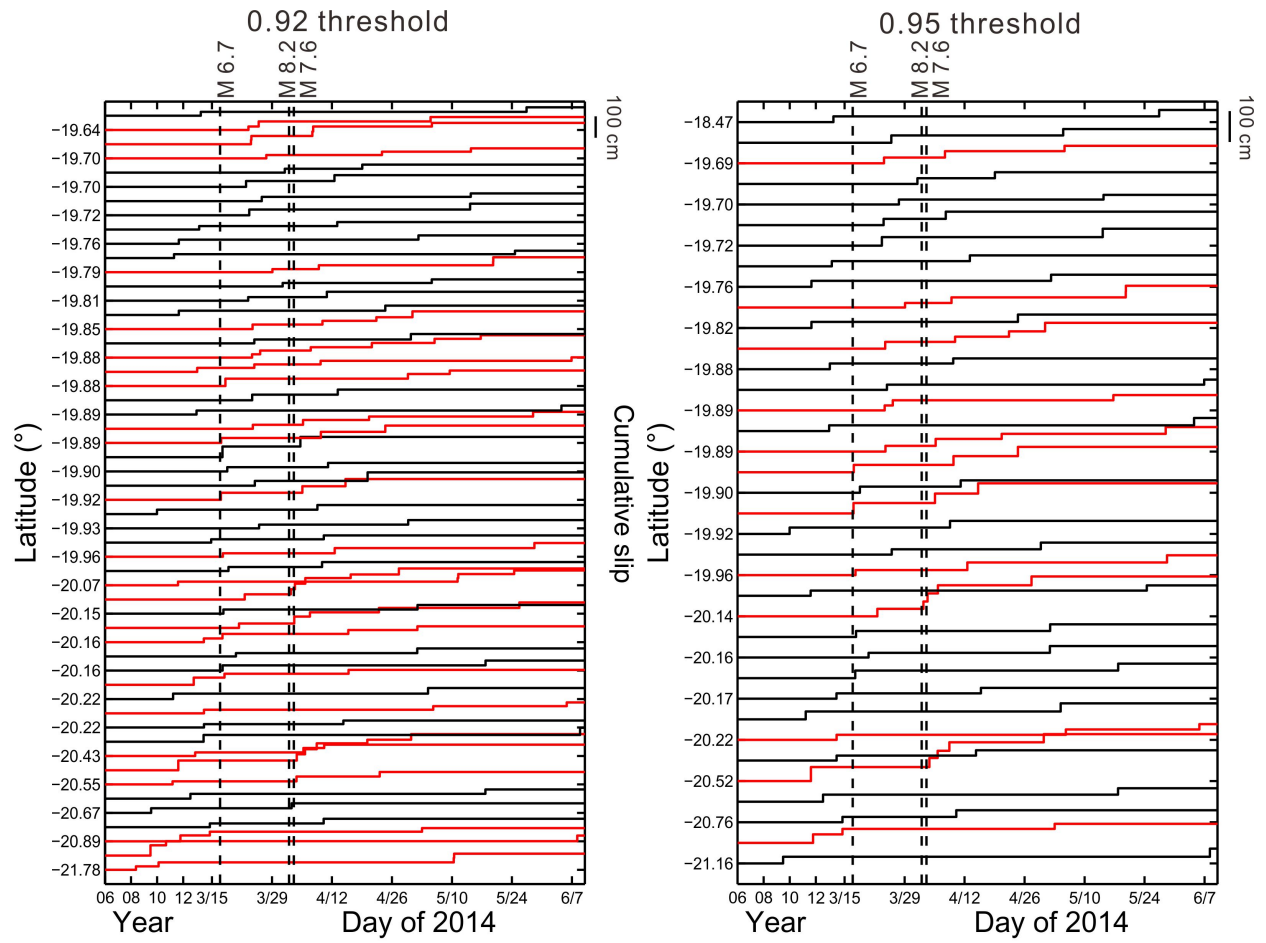
Figure S7. Cumulative slip for all preseismic-only repeating sequences with thresholds of 0.92 and 0.95 (green circles in Figures S2a and S2b), sorted by the averaged latitude of repeating events in each group. The red lines denote groups with three or more events.



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55 Figure S8. Same as Figure S7, but for all postseismic-only repeating sequences (yellow circles

56 in Figures S2a and S2b).



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58 Figure S9. Same as Figure S7, but for all pre-and-postseismic repeating sequences (red circles

59 in Figures S2a and S2b).

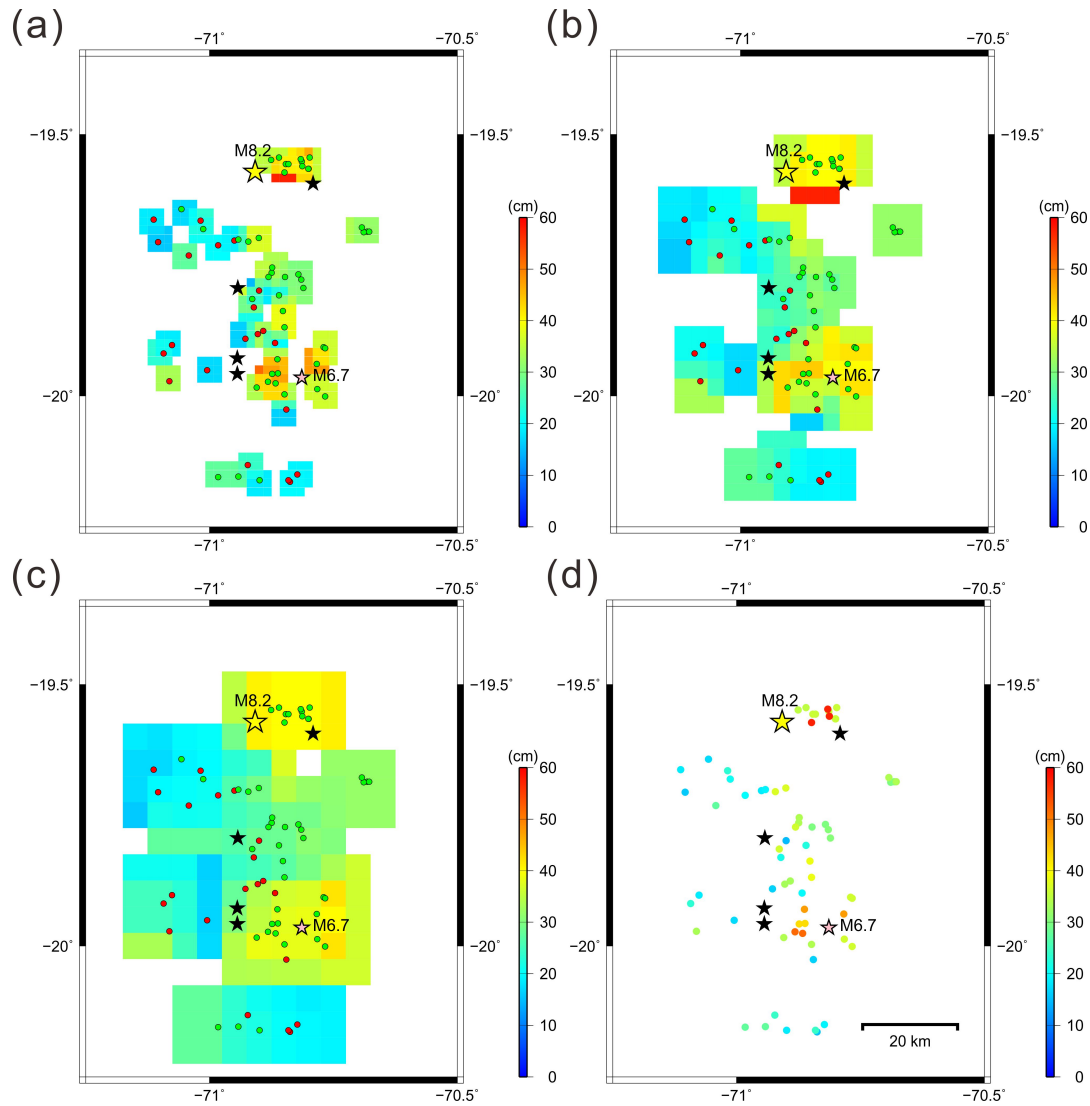
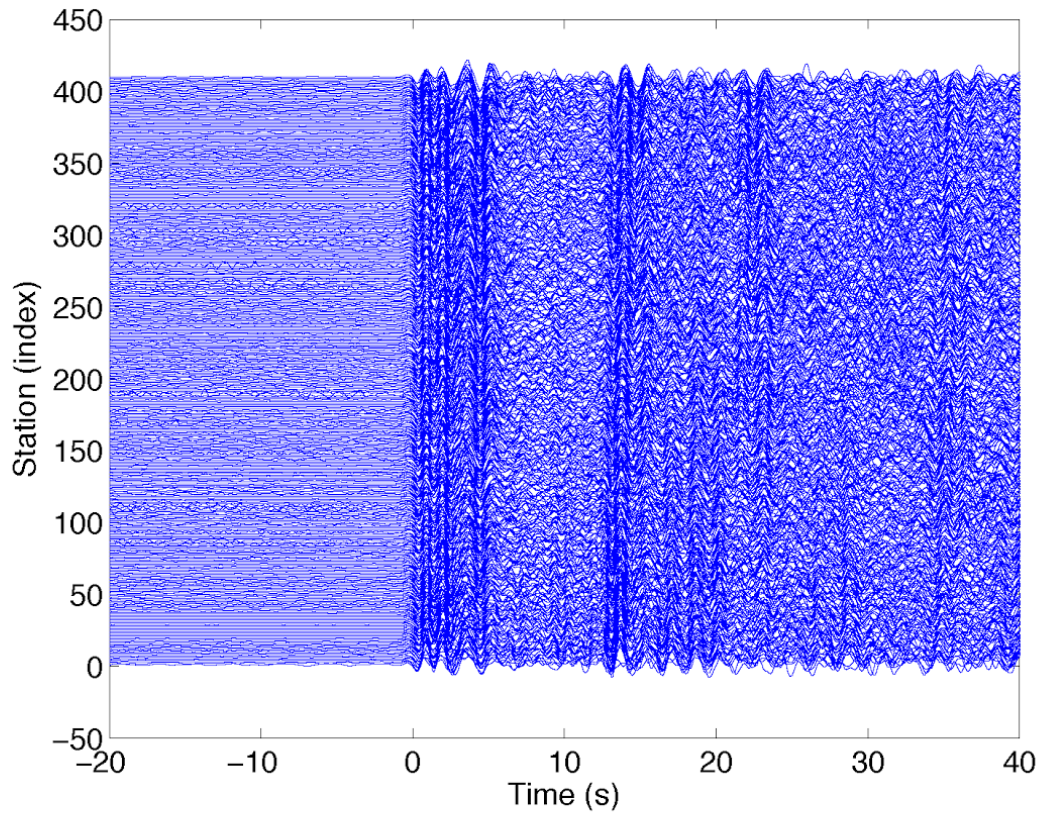


Figure S10. (a)-(c) show the interpolated value of aseismic slip (colored boxes) estimated from the individual cumulated slip of repeaters during the foreshock period, which are shown in (d). The slip value in each box is estimated by averaging the total slip of all the repeating groups in itself and its neighboring boxes. The box size is 0.05×0.05 deg (a), 0.1×0.1 (b) and 0.15×0.15 (c) in both latitude and longitude. Green and red circles in (a)-(c) indicate the locations of preseismic-only and pre-and-postseismic repeating earthquakes that occurred during the foreshock period. The black stars denote the epicenters of $M_w \geq 5.5$ events. The repeater-inferred aseismic moment are 2.0872×10^{19} Nm, 4.5327×10^{19} Nm and 7.0403×10^{19} Nm for (a), (b) and (c), respectively.



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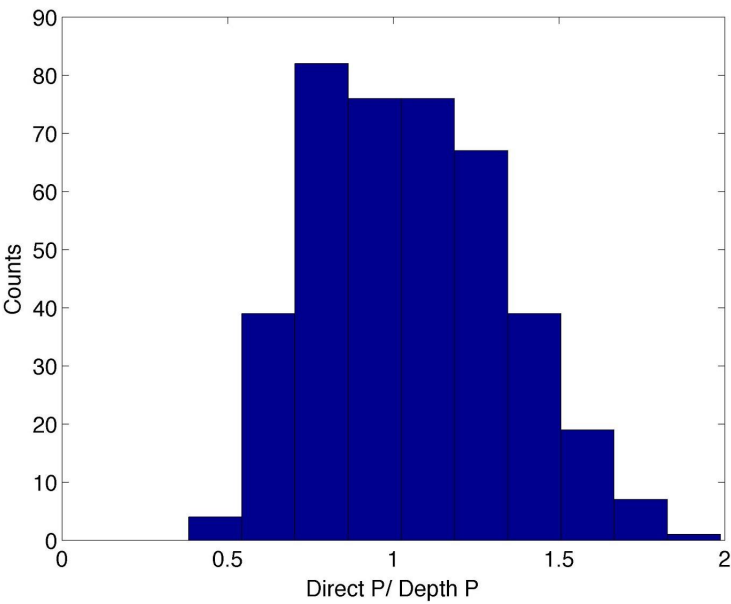
72 Figure S11. USArray Seismograms (0.5 - 2 Hz) of the Mw 6.5 event in central Chile. The direct P-wave

73 arrival is aligned at time zero. The depth phase pP arrives about 15 s later than the direct P. The

74 amplitude of the depth phase is comparable to the direct phase.

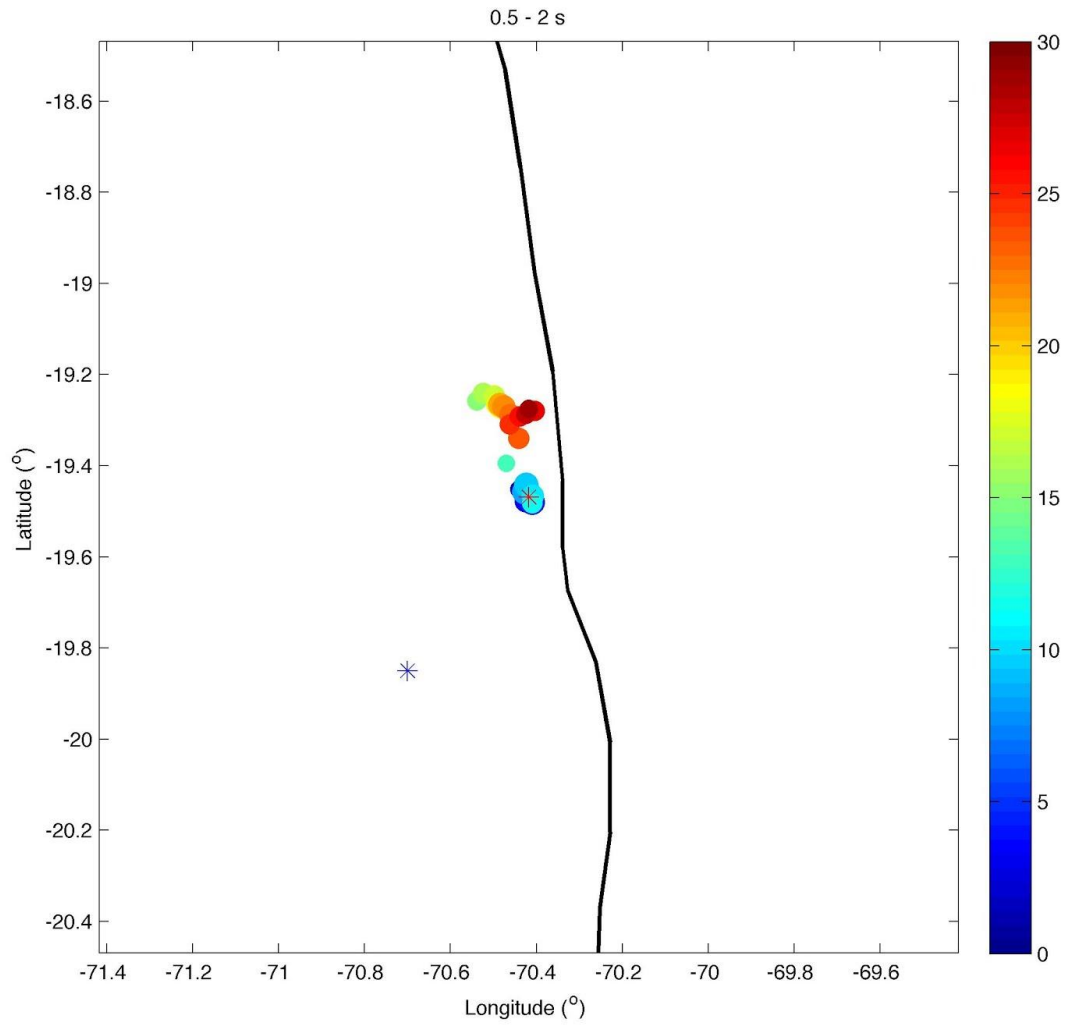
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78 Figure S12. Histograms showing the amplitude ratio of the direct phase P and depth P phase (pP) of the
79 Mw 6.5 event recorded by the USArray stations.



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81 Figure S13. BP imaging of the Mw 6.5 event. The apparent northward propagation is a bias due to the
 82 contamination of the depth phase.

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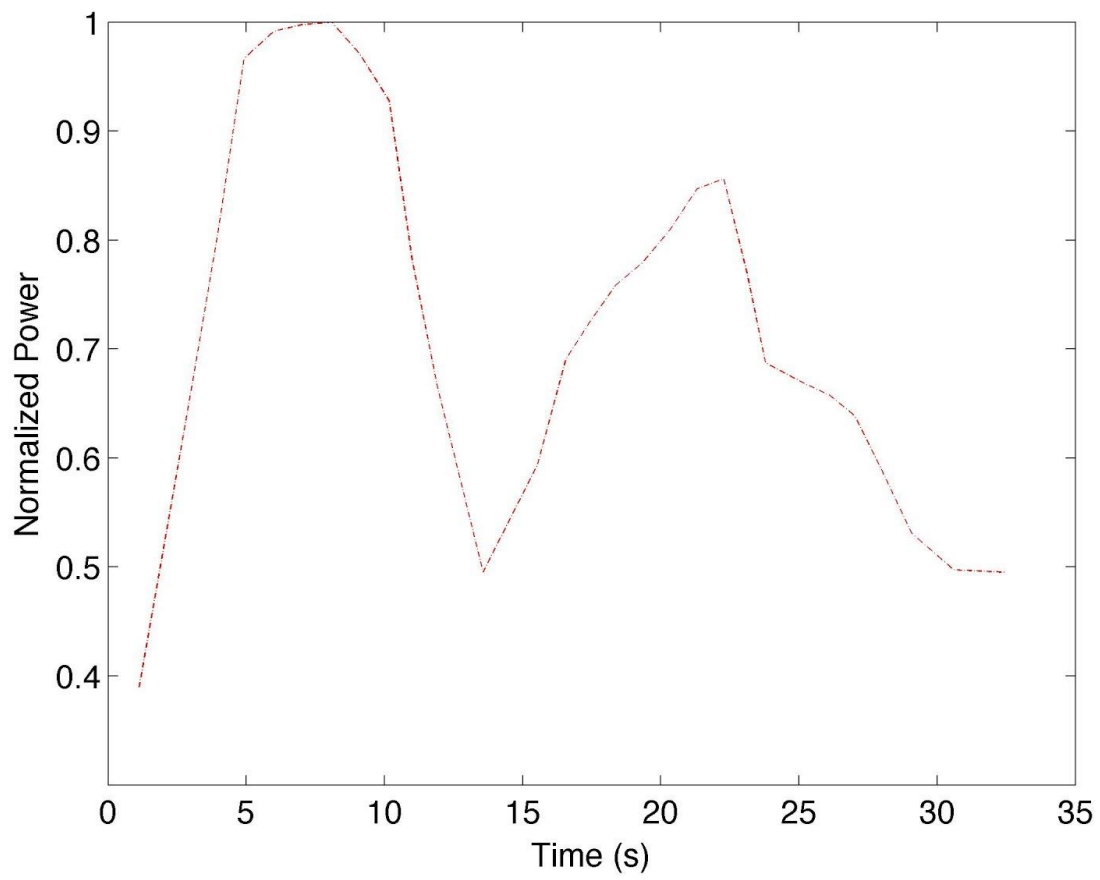


Figure S14. BP power for the M6.5 event. The second peak corresponds to depth phase arrival.